SITE: Barite Hill Nevada
BREAK: 2.1
OTHER:

D H E C
PROMOTE PROTECT PROSPER

C. Earl Hunter, Commissioner

Promoting and protecting the health of the public and the environment.

July 5, 2007

Leo Francendese
USEPA Region 4
61 Forsyth Street, S.W.
Atlanta, GA 30303-8960

Re: Barite Hill/Nevada Goldfields – Main Pit Water pH
SCD 987 597 903
McCormick, McCormick County, SC

Dear Mr. Francendese:

As requested, the South Carolina Department of Health and Environmental Control (SCDHEC) measured the pH of the Main Pit water at the Barite Hill/Nevada Goldfields site. The purpose of the sampling was to assess the impact of acid rock drainage (ARD) on the Main Pit water's pH.

Background

The Barite Hill/Nevada Goldfields site is located approximately 3 miles south of McCormick, South Carolina between US 378 and US 221 on the northern side of Road 30 in McCormick County, South Carolina. The mine site is relatively remote; there are no buildings, homes, or commercial buildings within 0.5 miles of the boundary. The site actively mined gold from 1991 to 1995. From 1995 until Nevada Goldfields filed for Chapter 7 Bankruptcy in 1999, the reclamation of the site was being addressed by Nevada Goldfields. On July 7, 1999 Nevada Goldfields abandoned the site.

The site is located along a topographic high ridge area forming the headwaters of an unnamed tributary to Hawes Creek. The topography of the area consists of rolling hills with ridgelines at an elevation of about 500 feet. Within the site, the ridgeline comprising the site has a high point of about 510 feet and an average elevation of approximately 480 feet.

The permitted mine site totals 795.2 acres. Of this total, 659.7 acres are designated as buffer area (areas not disturbed beyond the pre-mine natural state); therefore the maximum disturbance area is 135.5 acres.

The facility used a cyanide solution in a heap leach process to extract gold from ore. There are 7 processing ponds onsite containing an unknown amount of free-liquids. Three large, multi-acre, waste rock piles contaminated with cyanide are left onsite. Each waste rock pile has the potential for producing acid. Storm water run on and runoff are not controlled at the site. The Main Pit from the mining operations remains. The Main Pit contains approximately 100 million

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gallons of low pH water. Acid mine drainage (AMD) from seeps in Main Pit's east wall is being released to the unnamed tributary of Hawes Creek that borders the northern portion of the Main Pit.
The Main Pit at the Barite Hill/Nevada Goldfields site extends below the phreatic surface. When the mine was abandoned, pumping ceased, and the pit flooded. This introduction of water was the initial step in acid rock drainage. The waste rock stockpiles surrounding the eastern and southeastern portions of the Main Pit continue to be a source of acid rock drainage.

After being exposed to air and water, oxidation of metal sulfides within the Main Pit's walls and stockpiled waste rock along the edges of the Main pit continue to generate acidity. Colonies of bacteria and archaea greatly accelerate the decomposition of metal ions. These microbes, called extremophiles for their ability to survive in harsh conditions, occur naturally in the rock, but limited water and oxygen supplies usually keep their numbers low. Special extremophiles known as acidophiles especially favor the low pH levels of abandoned mines. In particular, *Acidithiobacillus ferrooxidans* is a key contributor to pyrite oxidation.

Although a host of chemical processes contribute to ARD, pyrite oxidation is by far the greatest contributor. A general equation for this process is:

$$2FeS2(s) + 7O2(g) + 2H2O(l) \rightarrow 2Fe2+(aq) + 4SO42-(aq) + 4H+(aq)$$

The solid pyrite, when introduced to oxygen and water, is catalyzed to form Iron(II) ions, sulfate ions, and hydrogen ions. The hydrogen ions bind to the sulfate ions to produce sulfuric acid.

A Preliminary Assessment/Site Inspection (PA/SI) was completed on January 11, 2007. Sampling for the PA/SI included surface water, sediment, and on-site soil samples, portions of the site were screened utilizing a field portable InnovX XL440 XRF. An Expanded Site Inspection (ESI) and a Removal Site Evaluation (RSE) are currently in progress at the site.

Methodology

SCDHEC measured the Main Pit water's pH using one grab sample and four in-situ samples taken from four separate locations and depths. Two pH meters were utilized; an Orion Model 230A Handheld pH Meter and a YSI 556 MPS Multi-Probe Field Meter with a 36 feet long probe. The Orion Model 230A is capable of measuring pH and temperature. The YSI 556 MPS Multi-Probe Field Meter is capable of measuring pH, pHmv, Oxidation-Reduction Potential (ORP), temperature, conductivity, Dissolved Oxygen (DO), and barometric pressure.

Both instruments were calibrated with pH buffer solutions of 4.00 and 1.00 prior to sample data collection. The YSI 556 MPS Multi-Probe Field Meter was recalibrated after Sample 4 and the calibration was confirmed after Sample 5.

Measurements of pH were taken from the site's Main Pit in four separate locations and depths. Sample 1 was a grab sample taken from the eastern side of the haul road where the road enters the Main Pit water. The contours of the haul road formed a shallow area approximately 3 feet wide by 20 feet long and 6 to 10 inches in depth. Two hundred fifty milliliters was collected

from the surface to 3 inches in depth. The sample was tested using the Orion Model 230A pH meter. All other samples were tested using the YSI 556 MPS Multi-Probe Field Meter.

Sample 2 was taken from the eastern side of the haul road approximately 75 feet south from where the haul road enters the water. The Main Pit wall forms a cliff face at this location for an unknown depth. Sample 3 and 5 were taken from this same location at different depths in the water.

Sample 4 was taken from the western side of the haul road where the road enters the Main Pit water. The location is approximately 15 feet west of Sample 1.

Findings

The Main Pit water at the Barite Hill/Nevada Goldfields site was sampled at 4 different locations and 5 separate depths. Sample 1 had the highest pH detected, a 2.42 pH. The lowest pH, a –3.98 pH, was detected in Sample 4. Table 1 details all the sample results.

Barite Hill/Nevada Goldfields
Main Pit pH Sampling
July 3, 2007

Sample	Estimated Depth Below Water Surface (Feet)	pH	Temperature (Celsuis)	pHmv	Conductivity (us/cm)	Time
Sample 1	taken at surface	2.42	28.1	NA	NA	11:20 AM
Sample 2	5	-2.1	NR	NR	>4000	11:30 AM
Sample 3	30	-3.92	11.72	371.9	6121	11:35 AM
Sample 4	4	-3.98	22.88	389.3	3138	11:42 AM
Sample 5	25	-3.32	11.84	352.1	6172	12:02 PM

NA = not available
NR = not recorded

Based on the findings of this sampling event, it is evident that ARD is adversely affecting the quality of the Main Pit water.

Respectfully Submitted,

Timothy Kadar, Environmental Health Manager
State and Federal Site Assessment Section
SCDHEC Bureau of Land and Waste Management